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PRESSURE FLUID SUPPLY SYSTEM

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FIG. 1.

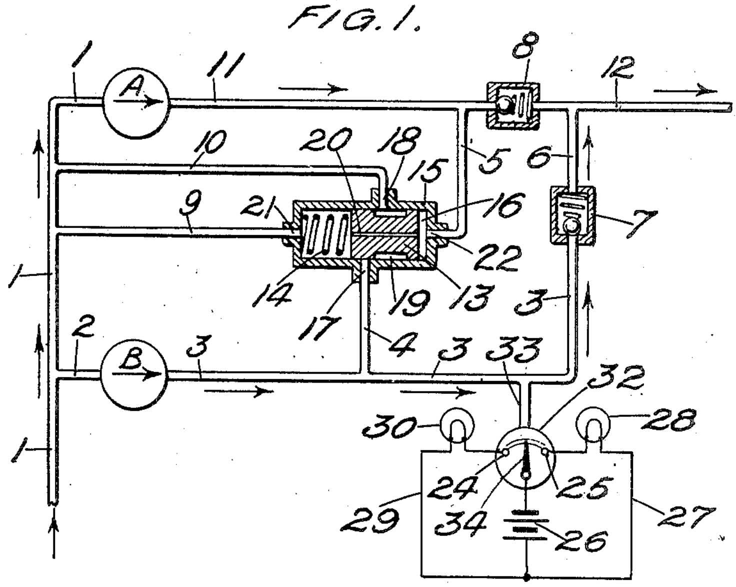
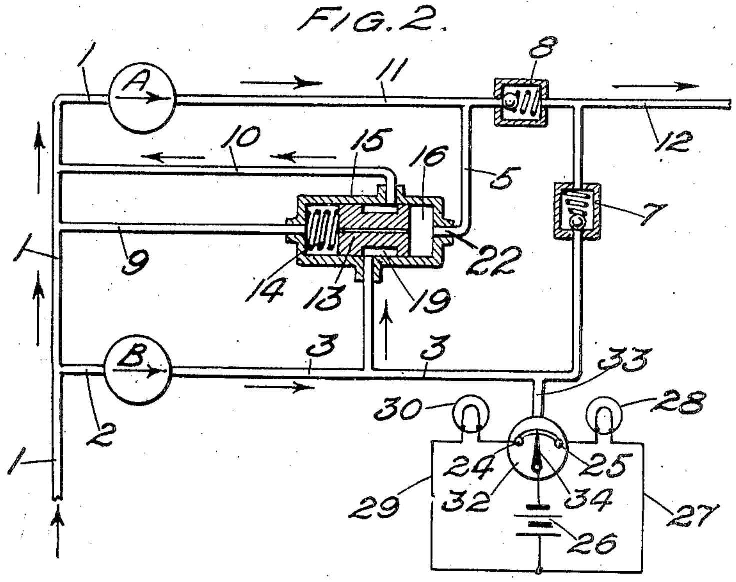


FIG. 2.



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PRESSURE FLUID SUPPLY SYSTEM

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1 Claim. (Cl. 103—5)

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This invention relates to pressure fluid supply systems and in particular to systems in which it is required to supply fuel for example to an aero engine under substantial pressure. Some classes of engine are dependent upon a pressure fuel supply for their operation, for example engines of the gas turbine class. Such engines comprise a compressor driven by a turbine mounted coaxially on the same shaft, the air drawn in by the compressor being delivered to a plurality of combustion chambers into which fuel is injected and the mixture ignited, the hot gases then being led to the turbine thus driving it, and being subsequently emitted to atmosphere. In the interest of reliability of operation it may be considered desirable to provide a system such that if a pump failure should occur the engine is not to be out of action and it is also found desirable at least in connection with gas turbine engines to provide a fuel system such that for starting purposes a rate of supply is available (at comparatively low pressure) which would require a larger capacity pump than is necessary for normal running after starting. The present invention seeks to provide a pressure fluid supply system in which dual pumps are afforded which meet the requirement of reliability and in which a comparatively large capacity is available for example to meet the requirements of starting a gas turbine engine. It is assumed in the following description that the pumps are mechanically driven by the engine itself although there may be cases where they are independently driven.

According to the invention a pressure fluid supply system comprises a pair of pumping elements for continuous operations, a common suction conduit and a common discharge conduit having suction and discharge branches respectively connecting the pumping elements in parallel for parallel suction and parallel discharge flow, non-return valves in both the discharge branches for permitting flow only in the direction of discharge, a main by-pass conduit connecting the discharge branch of one of the pumping elements from a point between the one pumping element and its non-return valve to the common suction conduit, a pressure actuated flow control valve means in the by-pass conduit for controlling the flow therein, and a pressure conduit connecting the discharge branch of the other pumping element from a point between the pumping element and its non-return valve to the pressure actuated flow control valve means for supplying it with pressure fluid from the other pumping element to actuate it, the valve

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means being biassed to close the by-pass conduit when the discharge pressure of the other pumping element is below a predetermined value to permit the pair of pumping elements to pump in parallel and discharge fluid to the common discharge conduit and the valve means being actuated by the pressure fluid when the discharge pressure of the other pumping element is above the predetermined value to open the by-pass conduit to permit the one pumping element to discharge fluid to the common suction while the other pumping element continues to discharge fluid to the common discharge conduit. In the event of failure of the other pumping element, the biassing load on the pressure actuated flow control valve means causes it to close the by-pass conduit and the one pumping element commences to pass fluid to the common discharge.

The invention will be better understood from the following description of one form of embodiment of the invention which is given by way of example with reference to the accompanying drawings in which:

Fig. 1 is a diagrammatic representation of a system according to the invention with the pressure actuated fluid flow control valve means closed;

Fig. 2 is a similar representation of the same system with the pressure actuated fluid flow control valve means open.

Referring to the drawings, the sytem according to the invention comprises two pumps A, B, for delivering fluid under pressure, the fluid being led from a source of supply through a main suction pipe connection 1.

A branch pipe 2 is connected to pipe 1 and leads to the suction side of pump B, the delivery side of this pump being connected through a pipe 3 to a non-return valve 7 and thence by a pipe 6 to a pipe 12 for delivery of the fluid to an apparatus.

Pipe 1 leads to the suction side of pump A of which the delivery side leads through pipe 11 to a non-return valve 8 and thence through pipe 12 to the apparatus wherein the delivered fluid is to be used.

Connected to pipe 3 is a branch pipe 4 leading through a lateral opening 17 to the chamber 16 of a pressure actuated flow control valve means consisting of a casing 15 enclosing said chamber 16 in which slides a piston valve 13 against the resistance of a spring 14. The chamber 16 can communicate through a port 18 and a pipe 10 back to the main suction pipe 1, the pipes 4 and 10 constituting a main by-pass conduit. The chamber 16 is connected by an opening 22 to a pipe 5 in communication with the pipe 11 and an opening 21 and pipe 9 which serves as a drain in a manner which will be hereinunder described, link the chamber 16 to the suction pipe 1.

A bleed line 20 is provided in the piston valve 13. An annular groove 19 is provided on the piston valve 13 to provide a passage for the fluid passing from the pump B when the lateral opening 17 is uncovered by the piston valve 13.

Fig. 1 represents the condition of the system when for example it is desired to start a gas turbine engine in which combustion is effected by means of burners (not shown) to which pipe 12 is connected for the delivery of fuel. The spring 14 is designed to yield at a certain predetermined pressure so that when the pressure of the fluid discharged by the pump A is less than this value, the pressure actuated flow control valve means is closed and there is no communication between ports 17 and 18, but when this pressure is exceeded, then the piston valve 13 is moved against the spring 14 and by means of the annular groove 19, ports 17 and 18 can then communicate with one another.

For starting conditions, the pressure actuated flow control valve means is closed as shown in Fig. 1 and pumps A and B are in this case operating in parallel. As indicated by the arrows which show the path of the liquid, pump B is supplying fuel via pipe 3, non-return valve 7 and pipe 6, while pump A delivers fuel through pipe 11, non-return valve 8 and pipe 12 to the burners. The pressure of the fuel delivered increases until it reaches the given pressure and when this value is reached the piston valve 13 moves against spring 14, thus putting ports 17 and 18 and consequently pipes 4 and 10 in communication with one another, as shown in Fig. 2. In this condition, as shown by the arrows, pump B circulates fuel idly and is operating on substantially no load while pump A continues to deliver and is alone responsible for delivering substantially all the fuel required at the desired pressure. The non-return valve 7 prevents pump A from delivering liquid back to suction via the pressure actuated flow control valve means.

If pump A fails, the pressure in its delivery line 11 drops and the piston valve 13 in the pressure actuated flow control valve means then moves back to the position of Fig. 1, thus cutting off communication between the delivery side of pump B and pipe 1. As shown by the arrows, pump B then delivers fuel through pipe 3, non return valve 7 and pipe 6 to the burners and is then itself responsible for delivering all the fuel at the required pressure.

If pump B fails while A is operating under load, then the system remains otherwise unaffected and pump A continues to deliver.

As the flow through a failed pump may in some cases be relatively small, a bleed line 20 is provided in the piston valve 13 of the pressure actuated flow control valve means in order to promote a rapid changeover. A lead 9 to drain is also provided in the said valve for the purpose of permitting leakage through the piston valve 13 to drain back to source and thus prevent any possibility of such leakage building up a pressure which together with the force exerted by the spring 14 on the piston valve 13 may operate to close the pressure actuated flow control valve means when this is required to remain open.

The pumps A and B are of the positive displacement type and they may be gear pumps actually driven from the engine shaft for example in the case of a gas turbine aero engine. Relief valves may be provided in association with any part of the system where the possibility of excess pressure may arise and the non-return valves may have associated with them any suitable signalling device to give an indication of the operative condition of the system at any one time.

One method of arranging such a signalling device is shown in Fig. 1. A pressure gauge 32 is connected by means of piping 33 to pipe 3 and the pressure in said gauge is indicated by a pointer 34 adapted to make electrical contact when the pressure is above a certain value with contact 25, and when the pressure is below another value with contact 24. A battery 26 is connected through a circuit 27 to a lamp 28 and also through a circuit 29 to a lamp 30 so that one of these lamps will light according to whether the pointer 34 is in contact with contact 25 or contact 24. When pump A fails the pressure in pipe 3 will exceed the value corresponding to contact 25 so that in this case pointer 34 will move over to said contact 25 and lamp 28 will light. Similarly if pump B fails, the pressure in pipe 3 will fall below the value corresponding to contact 24 and in this case lamp 30 will light. These lamps may be of different colours or otherwise suitably distinguished, and the illumination of one or other of the lamps will then indicate that either pump A or pump B has failed.

The pressure actuated flow control valve means may be provided with means such as spring loaded toggle linkage to give the valve a "snap" action so that it is held in one or other of its positions until there is a substantial change of conditions, flutter of the valve thus being avoided. Alternatively the valve may be operated electrically for example by a solenoid in a circuit which is itself affected by the operating conditions. Yet again the valve may be interconnected with a throttle or other user-controlled element so as to effect the changeover at some particular phase of use, and when the valve is manually operated, arrangements may be made whereby the valve is inevitably closed (i. e. returned to the parallel condition) if the main fuel supply be shut off as in closing down an engine.

I claim:

A pressure fluid supply system including a pair of pumping elements for continuous operation, a common suction conduit and a common discharge conduit having suction and discharge branches respectively connecting said pumping elements in parallel for parallel suction and parallel discharge flow, non-return valves in both said discharge branches for permitting flow only in the direction of discharge, a main by-pass conduit connecting the said discharge branch of one of said pumping elements from a point between said one pumping element and its said non-return valve to said common suction conduit, a pressure actuated flow control valve means in said by-pass conduit for controlling the flow therein, and a pressure conduit connecting said discharge branch of said other pumping element from a point between said other pumping element and its said non-return valve to said pressure actuated flow control valve means for supplying it with pressure fluid from said other pumping element to actuate it, said valve means being biased to close the said by-pass conduit when the discharge pressure of said other pumping element is below a predetermined value to permit said pair of pumping elements to pump in parallel and discharge fluid to said common discharge conduit and said valve means being actuated by said pressure fluid when said discharge pressure of said other pumping element is above said predetermined value to open said by-pass conduit to permit said one pumping element to discharge fluid to said common suction while said other pumping element continues to discharge fluid to said common discharge conduit.

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